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Heuristic optimization of Balanced Incomplete Block Designs

An approach to the construction of Balanced Incomplete Block Designs (BIBD) is described. The exact pairwise balance of treatments within blocks (second-order balancing condition) is required by standard BIBD. This requirement is attainable when $\lambda = b$
$binomk2/$
$binomt2$ is an integer, where t is the number of treatments, b is the number of blocks and k is the block size. This work presents an algorithm for generating BIBD with particular attention to settings where a second blocking variable is taken into account (Youden squares) and the blocks are assigned to s groups (sessions) where all treatments are equally represented inside each one.
Two real-world applications are presented. The first refers to an exploratory experiment with 8 two-level factors leading to t=20 trials, assessed by k=4 evaluators through b=20 blocks divided into s=4 balanced sessions. The second example refers to a robust design experiment based on a Central Composite Design involving 4 technological and 2 environmental factors leading to t=30 trials, evaluated in k=5 environmental conditions within b=30 blocks divided into s=5 balanced sessions. In these experimental settings, the second-order balancing condition is not attainable since λ is not an integer.
The proposed algorithm has been designed to approximate this condition as closely as possible, maintaining the first-order balancing condition.
The implementation of the algorithm has been implemented in the R environment.

Special/ Invited session

Classification

Both methodology and application

Keywords

BIBD, Heuristic Optimization

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Track Classification: Design of Experiments